

AMENDMENTS TO THE SPECIFICATION

The following references to line numbers refer to the line numbering set forth in the left margin of each page of the application.

Kindly replace the paragraph beginning on page 1, line 19 with the following amended paragraph.

In a conventional control apparatus for controlling a shift operation in an automatic transmission, torque transmitted to an off-going friction engagement element, which is adapted to be disengaged at a time of shifting in the automatic transmission, is required to be reduced in accordance with increase of torque to be transmitted to an on-coming friction engagement element, which is adapted to be engaged at the time of shifting. A one-way clutch has been employed for reducing the torque transmitted to the off-going friction engagement element. However, somewhat recent developments have led to a control apparatus for controlling a shift operation in an automatic transmission, in which a clutch-to-clutch shift operation is performed by controlling oil pressure to be supplied to a clutch for the on-coming friction engagement (hereinafter, referred to as an engaging clutch) and a clutch for the off-going friction engagement element (hereinafter, referred to as a disengaging clutch) by use of a software. In this case, a shift stage is switched in the automatic transmission by controlling each engaging and disengaging clutch in mutually mutual relation thereto.

Kindly replace the paragraph beginning on page 3, line 6 with the following amended paragraph.

Further, according to a conventional control apparatus for controlling a shift operation in an automatic transmission, which has been suggested by the applicant of the present invention, the disengaging clutch slips and a slip slip amount is maintained at an appropriate slip amount until the engaging clutch can be transmitted with sufficient torque. A racing amount of a turbine rotation is referred to for maintaining the slip amount at the appropriate slip amount. The racing amount of the turbine rotation can be determined by subtracting a value, which is calculated by multiplying an output rotational speed No by a gear ratio Gear1 of an actually selected shift stage, from a turbine rotational speed Nt. The feedback control can be performed for controlling the racing amount of the turbine rotation (= Nt – No·Gear1) to follow a target value.

Kindly replace the paragraph beginning on page 3, line 18 with the following amended paragraph.

In this case, the disengaging clutch has been designed to be released from the engaged condition and the engaging clutch is transferred to the disengaged condition along with control of the racing amount of the turbine rotation. Therefore, the transmission can be effectively prevented from the inter lock condition and the shifting feeling can be enhanced. Even when the increase of the oil pressure to be supplied to the engaging clutch is delayed, the oil pressure supplied to the disengaging clutch can be controlled at a preferable oil pressure level until the engaging clutch becomes ready for being supplied with the sufficient oil pressure.

Therefore, the control apparatus can effectively prevent the rotation of the engine or the turbine runner from largely racing such that the shift feeling can be effectively prevented from going becoming worse.

Kindly replace the paragraph beginning on page 23, line 28 and ending on page 24, line 6 with the following amended paragraph.

The CPU then proceeds to step 313 for controlling the disengagement indicating pressure (IPout) within a range of a predetermined bound pair. The CPU then proceeds to step 314 for judging whether or not the slip has disappeared. The judgment can be performed based upon the actual current slip amount Sp which has calculated at step 306. When the actual current slip amount Sp is substantially equal to or less than zero value, the CPU judges that the slip has disappeared. At this stage, the hydraulic pressure being supplied to the on-coming friction engagement element has been ~~sill~~ still small immediately after the commencement of the slip. That is, the on-coming friction engagement element has not been transmitted sufficient torque yet. Therefore, the current slip amount Sp is judged to be greater than zero value. A negative judgment (NO) is obtained at step 314 and the CPU returns to step 305 after the time pass, for example the time pass of 5 milliseconds. The CPU repeatedly performs steps 305 to 313 until the current slip amount Sp becomes substantially equal to or less than zero value.

Kindly replace the paragraph beginning on page 29, line 36 and ending on page 30, line 8 with the following amended paragraph.

According to the second embodiment, [[H]] a control problem is applied to the slip FB control. The same portion of the slip FB control to the one according to the first embodiment will not be described hereinafter for simplifying the description. According to the first embodiment, each gain for the integral-proportional control is derived by the model matching method with an understanding of the characteristics of the automatic transmission 30 (i.e. the controlled object) within the frequency domain such that the ideal slip response is obtained. However, according to the second embodiment, each gain for the integral-proportional control is computed as described below.

Kindly replace the paragraph beginning on page 30, line 10 with the following amended paragraph.

As illustrated in FIG. 20, a closed loop is defined with [[an H]] a controller $K(s)$ relative to the controlled object $P(s)$. In order to obtain a desired response from the closed loop, the [[H]] controller $K(s)$ is designed by adjusting an weight function such that a transfer function from a target value (the slip amount) w_1 to an actual slip amount (an observation amount) y becomes substantially equivalent to the reference model $M(s)$. Therefore, the tracking performance of the slip amount to the target slip amount can be improved. That is, the problem for obtaining the[[H]] controller $K(s)$ for approximating the response of the controlled object $P(s)$ to the response of the reference model $M(s)$ resolves to the [[H]] control problem regarding to the transfer function from the target value w_1 to a control amount z_1 . The control amount z_1

represents a deviation between the output from the reference model $M(s)$ and the observation amount y . The $[[H]]$ controller $K(s)$ is designed by adjusting the weight function so as to satisfy conditions of the $[[H]]$ norm, thereby enabling to assure the good tracking performance of the slip amount to the target slip amount.

Kindly replace the paragraph beginning on page 30, line 27 and ending on page 31, line 3 with the following amended paragraph.

Characteristic fluctuation of the controlled object is treated as a multiplicative fluctuation $\Delta(s)$. An input to the multiplicative fluctuation $\Delta(s)$ is a control amount z_2 and an output from the multiplicative fluctuation $\Delta(s)$ is a perturbation input w_2 (i.e. an input to a generalized plant). The $[[H]]$ controller $K(s)$ is designed by adjusting a weight function for stabilizing a transfer function between the perturbation input w_2 and the control amount z_2 . Therefore, the control amount z_2 can be effectively prevented from being affected by the perturbation input w_2 . That is, the problem for obtaining the $[[H]]$ controller $K(s)$ for restraining the affect by the characteristic fluctuation resolves to the $[[H]]$ control problem regarding to the transfer function from the perturbation input w_2 to the control amount z_2 . Further, the $[[H]]$ controller $K(s)$ is designed by adjusting the weight function for stabilizing the controlled object so as to satisfy the conditions of the $[[H]]$ norm.

Kindly replace the paragraph beginning on page 31, line 5 with the following amended paragraph.

According to the second embodiment of the present invention, as illustrated in FIG. 21, the controller $K(s)$ is designed resulting in the $[[H]]$ control problem with a constant Matrix Scaling D . More particularly, the controller $K(s)$ is designed from the generalized plant having an exogenous input $w(s)$ (i.e. an external input), a control input $u(s)$, a control amount $z(s)$, and an observation amount $y(s)$. A weight function $wm1(s)$ is designed for assuring the tracking performance of the controlled object and a weight function $wm2(s)$ is designed for assuring a stability thereof. The $[[H]]$ controller $K(s)$ can be designed by analyzing the known $[[H]]$ control problem relative to the generalized plant with a constant Matrix Scaling.

Kindly replace the paragraph beginning on page 31, line 16 with the following amended paragraph.

The designing of the $[[H]]$ control problem can be executed by adjusting the weight functions $wm1(s)$ and $wm2(s)$. The weight function $wm2(s)$ is substantially uniquely determined in response to the characteristic fluctuation of the controlled object. In the meantime, the weight function $wm1(s)$ possesses a degree of freedom for the designing. Therefore, the $[[H]]$ controller is designed by adjusting the weight function $wm1(s)$ so as to prevent the gain characteristics of the transfer function from the target slip amount $w1$ to the actual slip amount y (the control amount $z1$) from fluctuating within a low frequency region.

Kindly replace the paragraph beginning on page 31, line 26 with the following amended paragraph.

Next, a model reduction transaction is applied to the [[H]] controller K(s) designed as described above without changing the characteristics of the controller, each gain for the integral-proportional control is derived, and the [[H]] controller K(s) is then mounted in the microcomputer. Alternatively, the model reduction transaction is applied to the [[H]] controller K(s) designed as described above without changing the characteristics of the controller, and the [[H]] controller K(s) can be then mounted in the microcomputer.